Space Weather Technical Forecast

Issued on Saturday 8 February 2025 at 01:03 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: R1/R2 likely. G1 likely day 2 (09 Feb).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with four M-flares, the largest being M7.5 at 07/0921 UTC, from the northwestern cluster. There are now ten active regions on the Earth-facing disc. The majority of interest is in the northwest quadrant, with a cluster of entwined regions containing AR3976, AR3977, AR3978, AR3981 and AR3984. Of these, AR3981 remains the largest and most complex region on the visible disc, with three strong delta regions and continued development of the intermediate spots. The other regions within this cluster are close together and it is difficult to define the exact boundaries of each region. As such they are magnetically interconnected, with interaction between the various regions. The remaining regions on the disc are small and simple at present.

A faint CME is visible in some coronagraph imagery from the M7.5 flare, though after analysis this is likely to miss ahead of Earth.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1, showed a declining trend from possible coronal hole fast winds back to background. Wind speeds were initially slightly elevated around 470 km/s, declining gradually to slow-ambient speeds, around 350 km/s. The density was mostly average or below, on a slight rising trend. The Interplanetary Magnetic Field was weak, with peaks of 7nT. The north-south component, Bz, varied between +6/-2nT but was predominantly northward directed. The phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-1).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 remained at background levels.

High energy electron flux (greater than 2MeV) at GOES16 was at mostly background levels. The associated 24-hour fluence persisted below the Active threshold on a flat trend, recording 3.7e6 integrated pfu at 08/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is expected to continue, with a chance of an X-class flare, primarily from the cluster of regions in the northwest.

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Solar Wind / Geomagnetic Activity: There is a slight chance of up to three glancing CMEs through the period, one on day 1, and the other two on days 3 or 4.

Solar winds are now slow-ambient. The next feature, the High Speed Stream from CH13/-, is expected to arrive during day 2 (09 Feb), perhaps more likely during the second half of the day, lasting into day 3 (10 Feb). Solar winds are expected to become elevated to potentially strong at 500-600 km/s.

Predominantly Quiet to Unsettled (Kp 0-3) geomagnetic activity is expected, with a slight chance of Active to G1/Minor Storm intervals if we do see any CME influence day 1 and day 4 (08 and 11 Feb). Activity is then expected to increase during days 2 and 3 (09/10 Feb) due to the HSS from CH13, perhaps with some limited CME influence, becoming Active to G1/Minor storm (Kp 4-5) with a slight chance of G2/Moderate storm intervals (Kp 6).

Energetic Particles / Solar Radiation: There is a slight chance of S1/Minor radiation storm events as the cluster of sunspots in the northwest are now in a good position to connect with Earth, should there be further large flares. High energy electron flux observed at GOES16 is expected to be mostly at background levels, perhaps with a rising trend on day 4 (11 Feb). The corresponding 24 hour fluence is expected to persist below the Active threshold.

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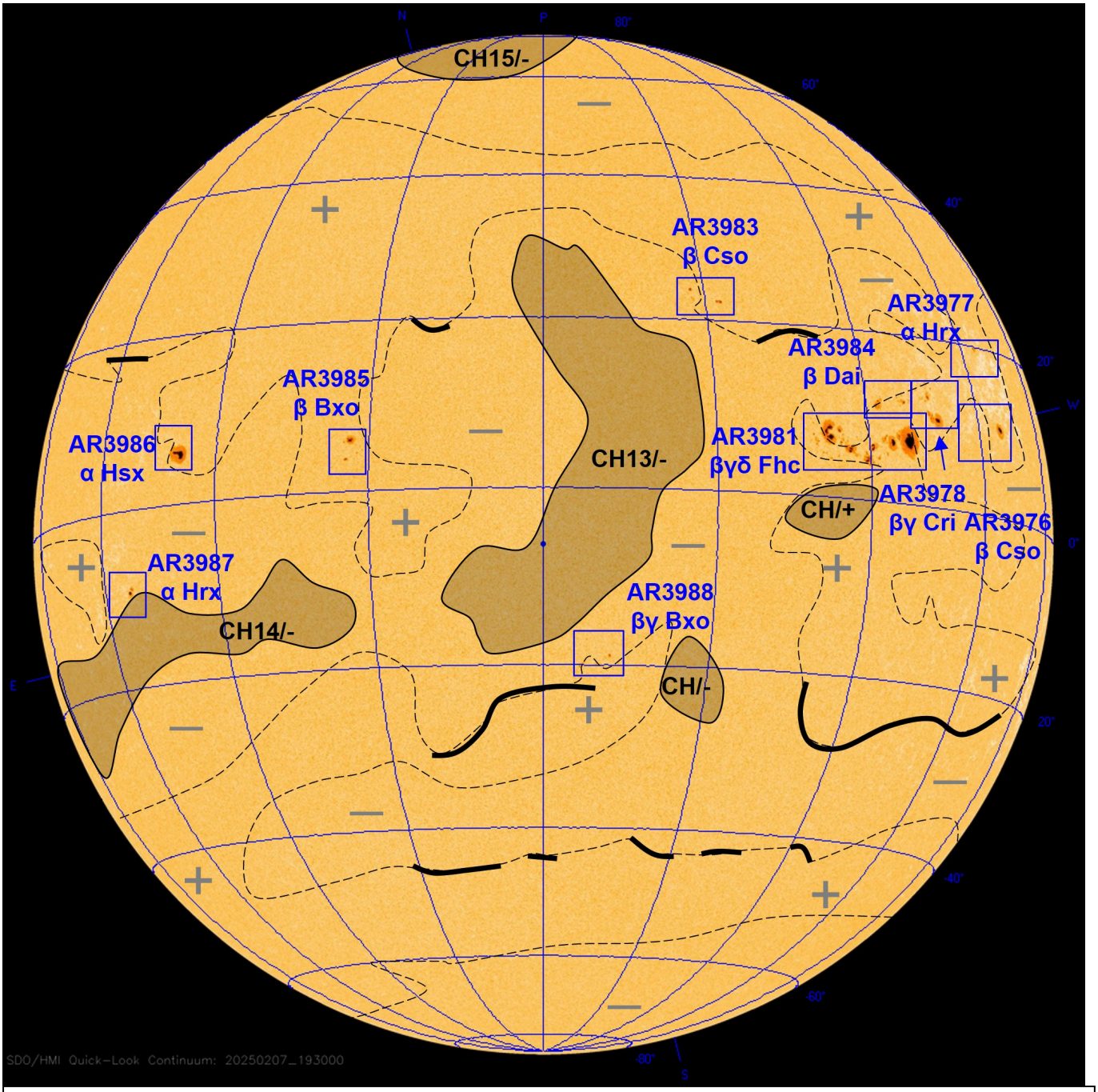
Figure 1: Solar synoptic map valid 07/1930UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A CME from a filament eruption in the southwest, from early on 05 February, has a low chance of delivering a glancing blow late early day 1 (08 Feb). There is a slight chance of up to two glancing blows from faint CMEs associated with two M7 flares on 06/07 Feb, which are both expected to get to 1AU later day 3 or day 4 (10/11 Feb).

Solar winds are now slow-ambient. The next recurrent feature, the High Speed Stream from CH13/-, is expected to arrive during day 2 (09 Feb), perhaps more likely during the second half of the day, lasting into day 3 (10 Feb). This feature appears to be larger and more intense compared to the previous rotation, when speeds reached around 450 km/s. On this rotation solar winds are expected to become elevated to potentially strong at 500-600 km/s, in line with MOSWOC Enlil expectations. However, Enlil may be too early for the HSS arrival at Earth.

Predominantly Quiet to Unsettled (Kp 0-3) geomagnetic activity is expected, with a slight chance of Active to G1/Minor Storm intervals if we do see any CME influence day 1 and day 4 (08 and 11 Feb). Activity is then expected to increase during days 2 and 3 (09/10 Feb) due to the HSS from CH13, perhaps with some limited CME influence, becoming Active to G1/Minor storm (Kp 4-5) with a slight chance of G2/Moderate storm intervals (Kp 6).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	60	40	20
Strong	G3	No	1	5	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
05/0645	Partial	Filament	SW	790	08/0000 +/- 6 hours	Low chance of glancing impact.
07/0200	Partial	AR3981	NW	300	10/2100 +/-12 hours	Low confidence.

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Figure 2:

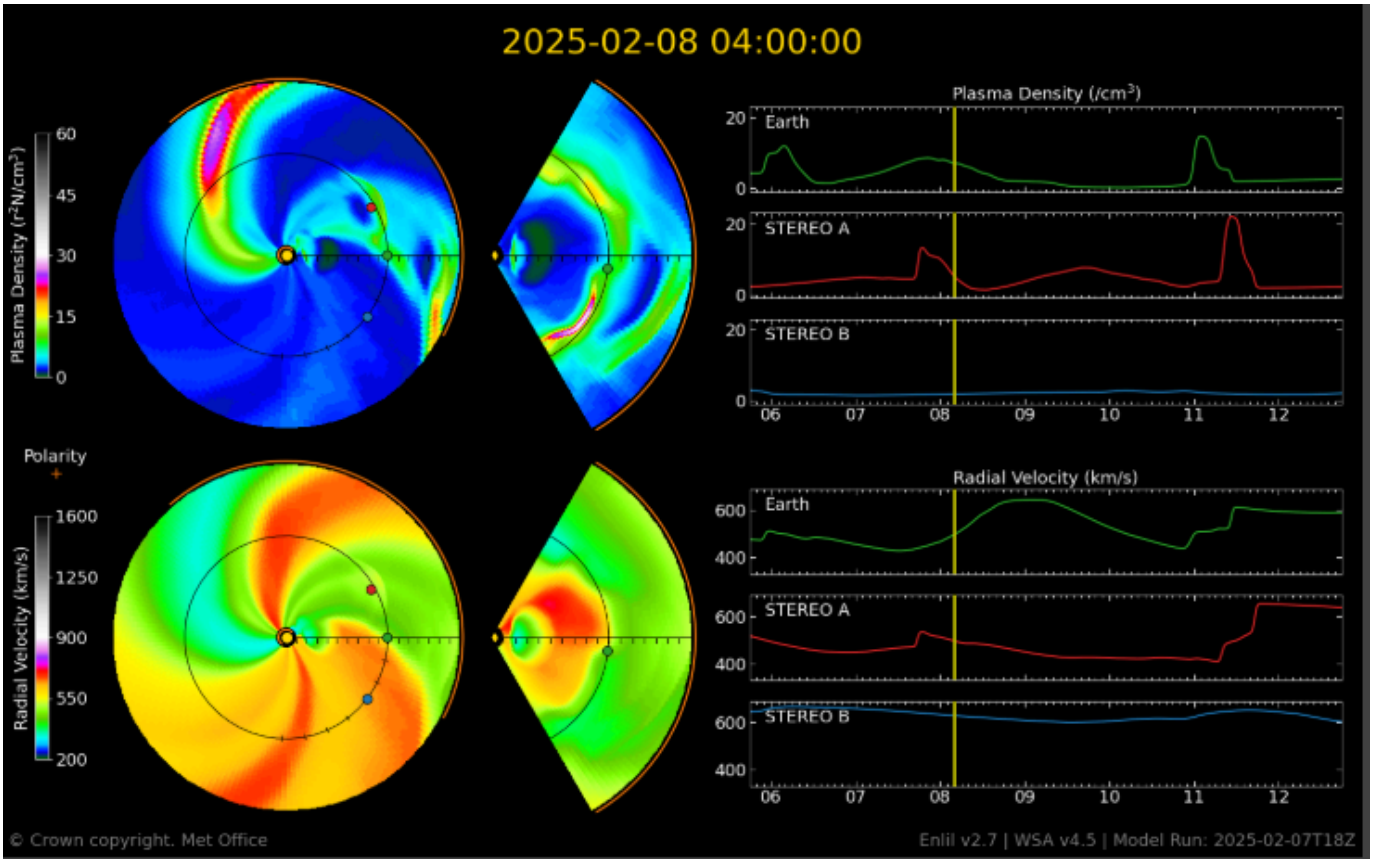
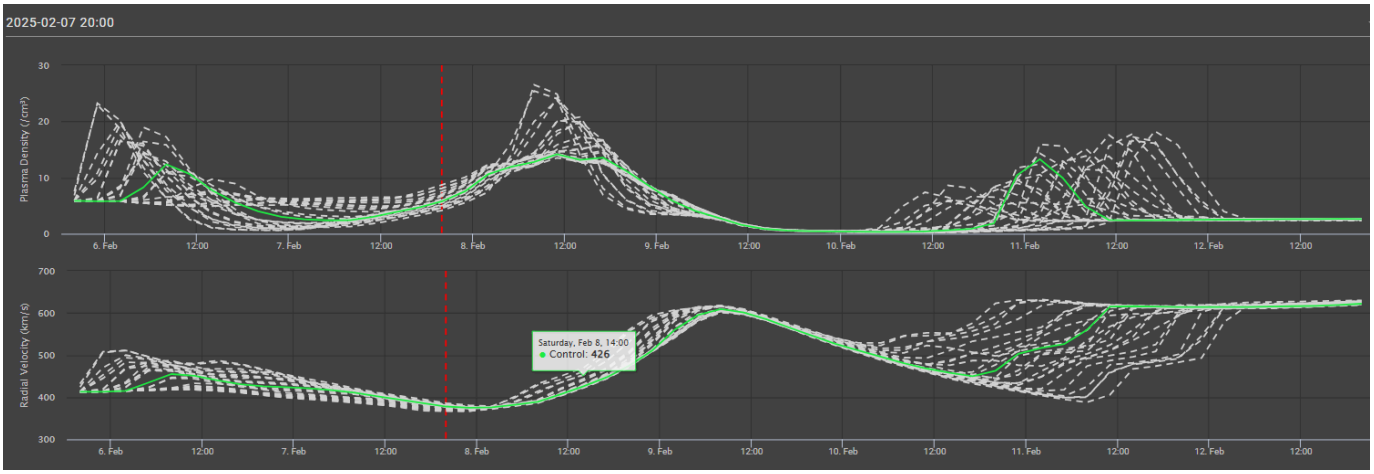


Figure 3: MOSWOC ENLIL Ensembles



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Radio Blackouts - X-Ray Flares

Solar activity has been Moderate with four M-flares, the largest being M7.5 at 07/0921 UTC, from the northwestern cluster.

There are now ten active regions on the Earth-facing disc. The majority of interest is in the northwest quadrant, with a cluster of entwined regions containing AR3976, AR3977, AR3978, AR3981 and AR3984. Of these, AR3981 remains the largest and most complex region on the visible disc, with three strong delta regions and continued development of the intermediate spots. The other regions within this cluster are close together and it is difficult to define the exact boundaries of each region. As such they are magnetically interconnected, with interaction between the various regions. The remaining regions on the disc are small and simple at present.

Further M-flares are likely, with a slight chance of an isolated X-class flare.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	70	70	70	70
Very Active	R3-R5 (X Class)	No	20	20	20	20

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Figure 4: 24 hours X-Ray trace.

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Solar Radiation Storms (High Energy Protons)

The northwestern cluster of sunspots, including AR3981, is now in a good position to connect with Earth and produce an increase in proton flux after any large flares. That said, none of the more notable flares have so far proven proton-rich, therefore the overall risk is remained at a slight chance of reaching above the S1/Minor radiation storm threshold throughout the period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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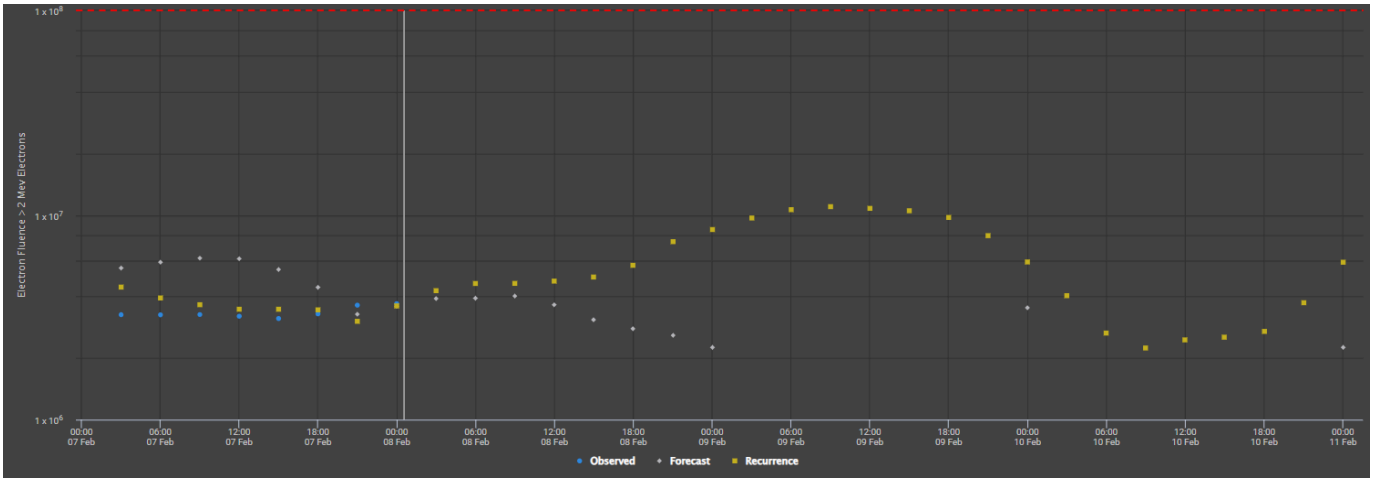
High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been at mostly background levels. The next likely charging mechanism for the Van Allen belts is CH13/-, but any subsequent significant rise in electron levels is expected to be beyond the current forecast period. Possible CME arrivals in the interim complicate this picture somewhat, but overall mostly background electron flux is expected until perhaps later on Day 4 (10 Feb).

The corresponding 24-hour fluence is expected to persist below the Active threshold through this period, perhaps with a rising trend later on day 4. MOSWOC REFM output shows levels well below Active through the next 72 hours, however this will not account for intervening CMEs nor the increased intensity of CH13/-.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ 1×10^{8}**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ 1×10^{9}**	No	1	1	1	1

Figure 5: MOSWOC REFM Integrated flux/fluence observations, forecast, recurrence.



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